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Original Article

DETERMINATION OF SELECTION INDICES AND PATH COEFFICIENT ANALYSIS OF YIELD AND ITS CONTRIBUTING CHARACTERS IN CHICKPEA (Cicer arietinum L.)

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ABSTRACT

This research study was administered within the fields of the Sam Higginbottom University of Agriculture, Technology and Sciences at the Department of Genetics and Plant Breeding, Prayagraj, Uttar Pradesh during the 2019-2020 rabi season for determination of the selection indices and path coefficient analysis of yield and its contributing characters in chickpea. The study consisted of 21 chickpea genotypes for 13 characters. The results revealed the direct effect and significantly positive total effect of biological yield of plant, harvest index, total seeds per plant and seed index on seed yield. This indicated the maximum contribution of these characters to the genotypes yield and thus, considered as vital selection indices for increasing the plant yield. Total pods per plant had a negative direct effect having a significantly positive correlation with the plant seed yield. So, the indirect selection of this character could also be effective.

KEYWORDS: Chickpea (Cicer Arietinum L.), Biological Yield, Correlation, Path Coefficient Analysis & Selection Indices

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INTRODUCTION

Legumes are important nutritious crops which help to fight against malnutrition of both the human population as well as the soil. One among the main pulses, growing in India and worldwide is chickpea. It is one of the foremost important Rabi pulse crops preferred mostly among all the pulses due to its high level of protein content and other nutritional content. The protein content of about 12.6 to 30.5 per cent and carbohydrates of 52.4 to 70.9 per cent together constitutes about 80 per cent of total dry seed weight besides ash, calcium, phosphorus and iron. It also contains unsaturated linoleic and oleic acid (**Karem *et al*., 2007**). Also, being legume crops have an important role in agriculture for fixing nitrogen and improving nutrient content within the soil. Thus, fights against malnutrition, increasing the necessity of finding out the selection indices for its yield improvement.

Chickpea is a self-pollinated and diploid crop species belonging to the genus *Cicer* and order *Fabales* and family *Leguminosae* (**Bentham and Hooker, 1870**). The origin place is known to be in Western Asia. The most widely cultivated species in India is *Cicer arietinum* (2n = 14). The Desi and Kabuli types of the cultivated chickpeas are divided on the basis of seed size and color (**Cubero, 1975**).

For various breeding programmes of chickpea, the association of yield and its contributing characters has to be understood well. Yield being a complex quantitative character influenced by various environmental

fluctuations, thus, there is a need for both direct as well as indirect selection for its yield. This will help to identify the selection indices more efficiently by considering the path coefficient analysis of seed yield and its contributing characters. The association of the yield with each of its component characters will help in the improvement of the crop. **Atta *et al*. (2008)**, **Hasan and Deb (2014)**, **Thakur and Sirohi (2009)**, **Yucel and Anlarsal (2010)** and others have suggested the utilization of path coeffiecient analysis in chickpea for estimation of the direct and indirect effects of varied component characters on seed yield. Correlation studies show the extent of association of these characters forming the basis of determination of the selection indices of a crop for its improvement. Only correlation does not provide precise information of the same. Thus, for knowing the direct and indirect contribution of each component characters on yield the utilization of the path coefficient analysis is necessary (**Nandan *et al*., 2010**). The plant seed yield and other quantitative characters are taken as independent and dependent factors respectively within the path analysis. **Srikanth *et al.* (2013)** in their study reported the highest direct effect of total pods per cluster, thus, suggesting a direct selection of this character would be useful to increase the seed yield. In path coefficient analysis, it was observed that maximum effects and indirect influences were exerted by plant height and total pods number per cluster. **Singh *et al.* (2017)** reported that the total seed yield per plant showed a highly significant and negative correlation with 50% flowering days whereas total pods per plant showed significantly positive correlation with this trait. In path analysis, total pods per plant and seedling length were observed as the vital traits having highest direct effect to the total secondary branches per plant and vigour index had high order of indirect effect on plant seed yield. **Mahmood *et al.* (2018)** investigated that harvest index, total pods per plant and seed index have positive and significant relation with grain yield alongside high positive and direct effect from the studies of correlation and path coefficient analysis. Therefore, these were the best characters for increasing the yield of chickpea.

MATERIALS AND METHODS

This recent study administered within the fields of the Department of Genetics and Plant Breeding in the Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh consisted of 21 genotypes of chickpea. It had been laid out in Randomized Block Design (RBD) consisted of three replications during the 2019-2020 rabi season with the objectives of determining the selection indices for increasing yield by studying the path coefficient analysis in chickpea.

The analysis done on 13 characters were 50% flowering days (50% FD), 50% pod setting days (50% PD), plant height (PH), maturity days (MD), total primary branches per plant (TPB), total secondary branches per plant (TSB), total seeds per pod (TS/Pod), total pods per plant (TP/Plant), total seeds per plant (TS/Plant), biological yield of plant (BY), seed index (SI), harvest index (HI) and seed yield per plant (SY/Plant). The data were taken on any of the five selected plants from each plot of all three replications. 50% FD, 50% PD and MD were taken from each plot. The genotypes taken were **ICC 30-20**, **ICC 21170**, **IPC 08-11**, **IPC 09-50**, **IPC 14-86**, **JAKI 9218**, **Flip 9-130C**, **ICC 12348**, **RBG 203**, **IPC 07-67**, **K-850**, **CSJ 556**, **IPCK 04-29**, **K-850(M)**, **BGD 9971**, **Flip 97-53C**, **EC 382437**, **PDE 02E**, **ICCV 96802**, **IPC 2000-17** and **Pusa 362**.

The observations calculated for mean data were subjected to statistical analysis for the various characters. The choice of selection indices will be based on the correlation analysis suggested by **Al-Jibouri *et al.* (1958)** and path coefficient analysis by **Dewey and Lu (1959)** where plant seed yield is independent variable and the other quantitative characters are dependent variables.

RESULTS AND DISCUSSIONS

The results of path coefficient analysis showed the utmost direct contribution of plant biological yield on the seed yield of plant along with harvest index, total seeds per plant and seed index with significantly positive total effect on plant seed yield. The direct effect as shown by the plant biological yield (0.942), harvest index (0.873), total seeds per plant (0.167), seed index (0.088), maturity days (0.046), 50% pod setting days (0.026), 50% flowering days (0.017), total primary branches per plant (0.031), total secondary branches per plant (-0.003), plant height (-0.004), total seeds per pod (-0.040) and total pods per plant (-0.063) at the phenotypic level. The correlation of total pods and total seeds per plant, seed index, plant biological yield and harvest index were found significantly positive **[Table 1]**. At genotypic level, the direct effect as shown by the plant biological yield (1.039), harvest index (0.881), 50% flowering days (0.065), total seeds per plant (0.060), seed index (0.060), total seeds per plant (0.035), total secondary branches per plant (-0.007), plant height (-0.010), maturity days (-0.023), 50% pod setting days (-0.026), total primary branches per plant (-0.047) and total pods per plant (-0.066). The correlation of maturity days, total pods per plant, total seeds per plant, seed index, plant biological yield and harvest index showed positive and significant values **[Table 2]**. The characters that remained showed non-significant relation with plant seed yield.

Bala *et al*. (2015) and Makarand *et al*. (2019) and Thakur and Sirohi (2009) in their study found similar results that the biological yield of plant and harvest index had the utmost direct contribution on the yield. Thus, the best selection parameters are considered to be biological yield and harvest index. Karadavut (2009) found an equivalent in lentils. Total pods per plant had significantly positive total effect on the seed yield but the direct effect on the seed yield of plant was negative **[Table 1 and 2]**. An equivalent goes with Mushtaq *et al*. (2013) whereas Jyotsna *et al*. (2016) and Saleem *et al*. (2002) observed the yield had positive association and direct effect with the total pods number per plant.

Thus, selection practiced for improving the total seeds and total pods per plant, plant biological yield, seed index and harvest index will end in the improvement of the seed yield of plant as they showed significantly positive correlation with yield. Path coefficient analysis revealed that total number of seeds per plant, seed index, plant biological yield, 50% flowering days and harvest index have positively direct effect on the seed yield at both genotypic and phenotypic levels **[Table 1 and 2]**. Ali *et al*. (2009) reported that biological yield, total number of seeds per pod and seed index had the utmost direct influence on the plant seed yield in chickpea. Togay *et al*. (2008) reported direct positive effect exhibited by plant biological yield and total pods number per plant in pea. By considering the correlation coefficients and path coefficient analysis, it's clearly evident of the selection that must be done for plant biological yield, harvest index, total seeds per plant and seed index for improving the yield. Hasan and Deb (2014) found seeds number per plant at genotypic level whereas plant height at maximum flower at phenotypic level had the utmost positive and direct effect on the yield. The indirect selection of total pods number per plant could be efficient in maximizing the yield. Total pods per plant as reported by Noor *et al*. (2003), Ciftci *et al*. (2004), Atta *et al*. (2008), Thakur and Sirohi (2009), Sharma and Saini (2010) Ali *et al*. (2011) and Padmavathi *et al*. (2013) had the utmost positive and direct effect on the seed yield.

CONCLUSIONS

Plant biological yield, harvest index, total seeds per plant and seed index could be the vital selection indices for the maximization of the seed yield in chickpea as evident from the results. Total pods per plant could also be considered effective for indirect selection.

Table 1: Phenotypic Path Coefficient Analysis of Yield Contributing Characters of Chickpea

	50% FD	50% PD	MD	PH	TPB	TSB	TP/ Plant	TS/ Pod	TS/ Plant	SI	BY	HI	SY/Plant
50% FD	**0.017**	0.010	0.008	0.008	-0.001	-0.005	-0.003	-0.001	-0.003	-0.005	0.002	-0.003	-0.047
50% PD	0.015	**0.026**	0.012	0.008	-0.004	-0.008	-0.009	-0.004	-0.009	0.001	0.007	-0.007	0.062
MD	0.022	0.020	**0.046**	0.018	-0.008	0.002	-0.006	-0.004	-0.012	0.004	0.012	-0.004	0.210
PH	-0.002	-0.001	-0.002	**-0.004**	0.000	0.001	0.000	-0.001	-0.001	0.001	-0.001	0.000	0.141
TPB	-0.002	-0.005	-0.006	-0.001	**0.031**	0.005	-0.006	0.011	-0.003	0.002	-0.011	0.007	-0.126
TSB	0.001	0.001	0.000	0.001	-0.001	**-0.003**	0.000	0.000	0.000	-0.001	0.000	-0.001	0.117
TP/Plant	0.013	0.021	0.009	-0.005	0.012	0.004	**-0.063**	-0.009	-0.057	0.028	-0.003	-0.022	0.368**
TS/Pod	0.002	0.006	0.004	-0.007	-0.014	-0.003	-0.006	**-0.040**	-0.015	-0.003	0.003	-0.009	0.154
TS/Plant	-0.032	-0.060	-0.043	0.020	-0.015	-0.010	0.151	0.063	**0.167**	-0.060	0.003	0.067	0.407**
SI	-0.024	0.002	0.007	-0.014	0.004	0.029	-0.039	0.007	-0.031	**0.088**	0.031	-0.006	0.325**
BY	0.123	0.263	0.241	0.206	-0.328	-0.026	0.043	-0.070	0.019	0.334	**0.942**	-0.469	0.552**
HI	-0.179	-0.221	-0.066	-0.088	0.197	0.132	0.307	0.202	0.352	-0.062	-0.435	**0.873**	0.427**
SY/Plant	-0.047	0.062	0.210	0.141	-0.126	0.117	0.368**	0.154	0.407**	0.325**	0.552**	0.427**	**1.000**

Table 2: Genotypic Path Coefficient Analysis of Yield Contributing Characters of Chickpea

	50% FD	50% PD	MD	PH	TPB	TSB	TP/Plant	TS/Pod	TS/Plant	SI	BY	HI	SY/Plant
50% FD	**0.065**	0.038	0.031	0.037	-0.013	-0.022	-0.015	-0.013	-0.013	-0.021	0.008	-0.007	0.047
50% PD	-0.015	**-0.026**	-0.010	-0.008	0.006	0.008	0.009	0.008	0.009	-0.001	-0.010	0.007	0.144
MD	-0.011	-0.009	**-0.023**	-0.009	0.007	-0.002	0.003	0.006	0.005	-0.002	-0.007	0.001	0.297*
PH	-0.006	-0.003	-0.004	**-0.010**	0.000	0.003	-0.001	-0.002	-0.001	0.002	-0.003	0.002	0.123
TPB	0.009	0.011	0.015	0.002	**-0.047**	-0.009	0.013	-0.036	0.006	-0.007	0.019	-0.017	-0.101
TSB	0.003	0.002	-0.001	0.003	-0.001	**-0.007**	0.001	0.000	0.001	-0.002	0.001	-0.001	0.046
TP/Plant	0.015	0.024	0.009	-0.005	0.018	0.007	**-0.066**	-0.010	-0.063	0.032	-0.003	-0.026	0.366**
TS/Pod	-0.007	-0.011	-0.009	0.006	0.026	0.001	0.005	**0.035**	0.014	-0.001	-0.007	0.008	-0.009
TS/Plant	-0.012	-0.021	-0.014	0.006	-0.007	-0.009	0.057	0.024	**0.060**	-0.029	-0.002	0.025	0.322**
SI	-0.019	0.003	0.006	-0.011	0.008	0.019	-0.029	-0.002	-0.029	**0.060**	0.022	-0.009	0.275*
BY	0.122	0.381	0.331	0.276	-0.421	-0.087	0.042	-0.217	-0.034	0.376	**1.039**	-0.492	0.640**
HI	-0.097	-0.245	-0.033	-0.165	0.323	0.143	0.347	0.199	0.366	-0.131	-0.417	**0.881**	0.371**
SY/Plant	0.047	0.144	0.297*	0.123	-0.101	0.046	0.366**	-0.009	0.322**	0.275*	0.640**	0.371**	**1.000**

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